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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

A Seeding Test with Fourwing Saltbush (Chamiza) in Western New Mexico

H. W. Springfield [1]

Fourwing saltbush, generally called chamiza in New Mexico (Atriplex canescens (Pursh) Nutt.) is one of the most important and best known range shrubs in the Southwest. It provides forage the year around and is especially valuable as a source of energy and nutrients for livestock and game during winter and spring.

Seeding of chamiza on rangelands where adapted has been recommended by several investigators (Wilson, 1931; Bridges, 1941 and 1942; Reynolds et al., 1949). Little information is available, however, on how best to prepare the seedbed and plant the seed to obtain satisfactory stands.

This report summarizes results of experiments at one site in western New Mexico to compare the effects of different methods of seeding and seedbed preparation on the establishment, survival, and growth of chamiza.

LITERATURE REVIEW

Studies in New Mexico by Wilson (1931) showed that seed produced near Las Cruces at an elevation of 3,900 feet grew poorly near Galisteo, 220 miles north at an elevation of 6,100 feet. But chamiza grew well from seed collected near Estancia, which is only about 40 miles south of Galisteo. Springfield and

Figure 1.--

Pitting disk in operation.

1/ Range Conservationist, located at the Station's project headquarters at Albuquerque, in cooperation with the University of New Mexico; central headquarters are maintained at Fort Collins in cooperation with Colorado State University.

Housley (1952) found seed collected in northern New Mexico gave better results at sites throughout the State than seed collected in southern New Mexico; also that spring and midsummer seedings were more successful than fall seedings.

Bridges (1941) reported that, of 26 trials with chamiza near Las Cruces, 11 were failures, 15 were partially successful, and 1 produced a good stand. He attributed the failures to poor seedbed preparation and seeding at the wrong time of year, and stated that a seedbed that will help hold the available moisture and also insure proper covering of the seed is apparently necessary.

Anderson and Swanson (1949) described the pitting disk and cultipacker-seeder as efficient companion units that provide for moisture conservation, prepare a firm seedbed, and plant at varying depths in a single operation. Anderson et al. (1957) reported that chamiza is the only shrub that showed any promise for seeding in the desert grassland of the Southwest. They recommended the seed be "de-winged" in a hammermill for easy handling.

In southern Arizona and western Texas, according to Barnes et al. (1958), a pitted seedbed will insure establishment of a grass stand where nonpitted areas result in complete failure, they attributed the difference to increased moisture. Effective life of the pits was found to vary from 4 to 5 years in the Southwest desert to 10 years on the shortgrass plains. Pitting is recommended for native ranges in Wyoming where studies have shown substantially higher forage yields and grazing capacities on pitted range than on unpitted range (Rauzi and Lang, 1956; Lang, 1958; Rauzi et al., 1962).

A number of investigators have reported better grass establishment where some form of packing or soil firming is used. In studies with wheatgrass in Oregon, Hyder et al. (1955) concluded that rolling is a reliable method of covering broadcast seed and firming the seedbed on freshly plowed areas. The operation is limited in efficiency, however, because compaction of the soil above the seed reduces emergence and may restrict germination due to poor aeration. Other studies with wheatgrass in Colorado by McGinnies (1962) showed that cultipacking improved seedling stands. Packing before seeding was better than packing afterwards.

PROCEDURES

The experimental area is located near the Monica Guard Station on the Cibola National Forest, 22 miles southwest of Magdalena, New Mexico. Elevation is 7,500 feet; estimated

Figure 2.--Some methods tested:

A, cultipacker-seeding on unprepared seedbed;

B, cultipacker-seeding on pitted seedbed;

Figure 3.--
Chamiza plants were counted within a milacre and measured in 1962 to determine survival and development.

annual precipitation is 12 inches; and the soil is a shallow, gravelly loam. Native vegetation consists principally of blue grama (Bouteloua gracilis (H.B.K.) Lag.), ring muhly (Muhlenbergia torreyi (Kunth) Hitchc.), three-awns (Aristida spp.), wolftail (Lycurus phleoides H.B.K.), broom snakeweed (Gutierrezia sarothrae (Pursh) Britt. & Rusby), and widely scattered juniper (Juniperus spp.) trees. Relative amounts and composition of the native grass cover in 1951 were as follows:

	Ground cover, line intercept (Percent)	Yield, air-dry (Pounds per acre)
Blue grama	6.2	96
Three-awn	.6	12
Wolftail	.1	7
Ring muhly	.6	Not clipped

Two methods of seeding and four kinds of seedbeds were compared. Methods of seeding included: (a) drilling and (b) cultipacker-seeding. Seedbeds were prepared by: (1) plowing, (2) pitting, (3) plowing and pitting, (4) no cultural treatment.

Field plots were arranged in two blocks with a split-plot design. Seedbed-preparation plots were 16 1/2 by 132 feet, or 1/20 acre. Each method-of-seeding plot, which embraced four of these smaller plots, was 66 by 132 feet. A constant seeding rate of 20 pounds or 250,000 viable seeds per acre was used for all comparisons. The chamiza seed obtained from the U.S. Soil Conservation Service

C, cultipacker-seeding on plowed seedbed;

D, drilling on unprepared seedbed and (foreground) pitted seedbed.

Nursery near Albuquerque and dewinged in a hammermill had been collected from shrubs planted June 25-29, 1951.

Plots were plowed with a two-disk plow pulled by a small, wheel-type tractor. The disks were 26 inches in diameter. The soil was plowed to a depth of 5-6 inches, and pitting was done with a "cutaway" disk.[2] About half of each disk had been cut off, and the disks were arranged on the main shaft so that the cut half of adjacent disks faced in opposite directions. Pits prepared with this implement were about 4 to 6 inches deep, 8 to 12 inches wide, 24 to 30 inches long, and 18 inches apart. The soil was very dry and became almost powdery after it was plowed or pitted.

Seed was drilled with a regular 6 1/2-foot grain drill. The drill was equipped with single-disk furrow openers and drag chains, but no depth regulators. Cultipacker-seeding was done with a special seeder.[2] The rear set of rollers was shifted 2 inches so as to run in the same track as the front rollers. Small seed hoppers were so mounted that the seed fell into the grooves made by the first roller and were pressed into the soil and covered by the rear roller. Equipment used in the experiment and types of seedbed prepared are shown in figures 1 and 2.

After the experimental site was seeded, it was fenced to exclude livestock. Rabbits, however, were not excluded.

Results of the experimental seedings were evaluated by various means in 1951, 1952, 1953, and 1962. On August 29, 1951, chamiza seedlings were counted in a 1-foot-square frame located randomly 20 times in each plot.

In October 1952 and 1953, yield of the young chamiza stands was estimated on ten 9.6-square-foot circular plots located at random within each seeded area. Yield in grams per plot was estimated by the weight-estimate method.

2/ The Nursery Division, U. S. Soil Conservation Service, Albuquerque, New Mexico, furnished the cutaway disk and cultipacker-seeder. The cultipacker-seeder was a special seeder constructed by Joe Downs and Darwin Anderson of SCS.

In August 1962, survival and development of chamiza plants were determined by plant counts and measurements. A milacre sampling frame, 6.6 feet square, was located at random 15 times within each plot. Height and diameter of every plant in the plot were measured to the nearest inch (fig. 3).

RESULTS

Seedling Emergence and Early Growth

Emergence of chamiza 2 months after seeding varied from 5.2 to 60.1 seedlings per milacre:

Method of seedbed preparation	Grain drill (Number of seedlings per milacre)	Cultipacker-seeder
None	9.6	5.2
Pitted	24.0	30.5
Plowed	29.6	60.1
Plowed-pitted	25.3	48.8

Though the number of seedlings on pitted, plowed, or plowed and pitted seedbeds ranged from 24 to 60 per milacre, average differences were not significant. As might be expected, however, significantly fewer seedlings emerged on unprepared seedbeds. It is of interest that nearly half as many seedlings emerged on an unprepared seedbed as on a pitted seedbed where the seed was drilled into the soil.

In an overall comparison, seedling emergence on plots seeded with a cultipacker-seeder was about the same as that where the seed was drilled. There was a trend, however, toward more seedlings wherever the cultipacker-seeder had been used on loose seedbeds. Drilling on a plowed or plowed-pitted seedbed may have covered some seed too deeply. On unprepared seedbeds, however, drilling apparently resulted in better seed placement and coverage than did the cultipacker-seeder.

Production of the young chamiza stands, determined from estimates in 1952 and 1953, was significantly higher on plowed and plowed-pitted seedbeds than on the other two kinds of

Table 1.--Production of young chamiza stands by method of seedbed preparation and method of seeding

Method of seedbed preparation	Production of chamiza (estimated air-dry weight per acre)			
	Grain drill		Cultipacker-seeder	
	1952	1953	1952	1953
	Pounds			
None	20	71	3	30
Pitted	39	112	21	97
Plowed	102	257	91	222
Plowed-pitted	100	205	87	239

seedbeds (table 1). Apparently, moisture relations on the plowed seedbeds were more favorable for establishment and growth of the young plants. The difference in yield between pitted and unprepared seedbeds was not significant. Neither was the difference between seeding methods.

Yields in 1953, when the chamiza stands were 2 years old, were twice as high on plowed seedbeds as on pitted seedbeds. The yield of native grasses on the untreated check plots that year averaged only 115 pounds per acre, compared with chamiza yields of more than 200 pounds per acre on plowed seedbeds and about 100 pounds on pitted seedbeds.

Condition of 11-Year-Old Stands

Eleven years after the plots were seeded, some differences among chamiza stands were still evident (fig. 4). A significantly greater number of plants was present on prepared than on unprepared seedbeds:

Method of seedbed preparation	Grain drill	Cultipacker-seeder
	(Number of seedlings per milacre)	
None	5.0	5.2
Pitted	11.6	10.4
Plowed	11.2	13.2
Plowed-pitted	9.4	16.4

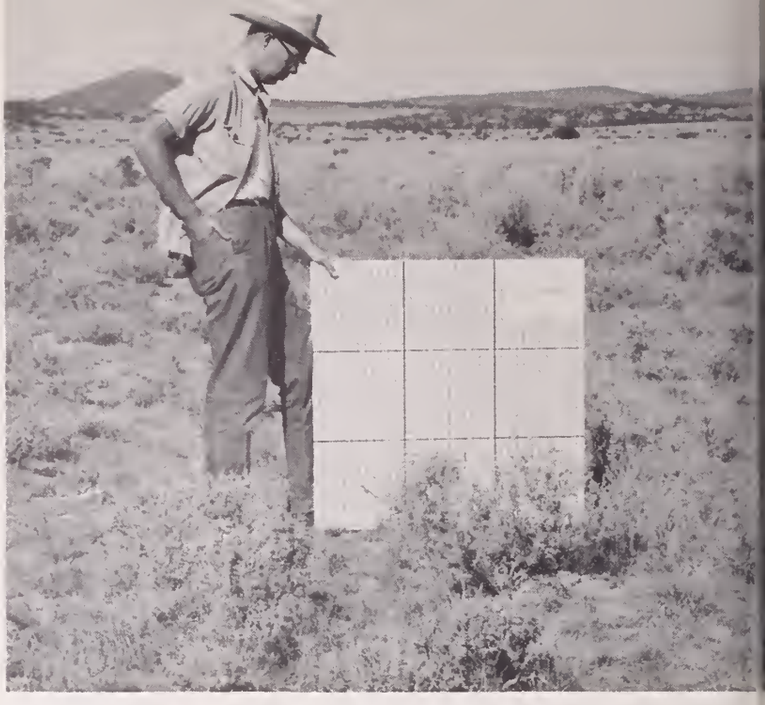
No differences in number of plants were measured, however, among pitted, plowed, or plowed-pitted seedbeds.

Comparisons of the two seeding methods indicated better stands where cultipacker-seeding was used on plowed seedbeds and where drilling was used on pitted seedbeds. Beneficial effects of cultipacker-seeding were especially noticeable on plowed-pitted seedbeds. This may be explained by the firmer seedbeds and better moisture relations obtained from cultipacker-seeding than those from drilling into the loose soil left by plowing and pitting.

Density of stocking of all stands on the prepared seedbeds was considered fully satisfactory. Standards proposed for chamiza stands, based on limited study, are as follows: Good stand--more than 6,000 mature plants per acre; Fair stand--1,000 to 6,000 plants per acre; Poor stand--less than 1,000 plants per acre. By these standards, the stands on unprepared seedbeds were fair and those on prepared seedbeds were good.

The number of dead chamiza plants present in 1962 was low on all plots--from 0.4 to 1.2 percent of the total number of plants observed. Despite this evidence of low mortality, many seedlings that emerged in 1951 failed to become established or died during the intervening years. Fewer than half the

Unprepared seedbed



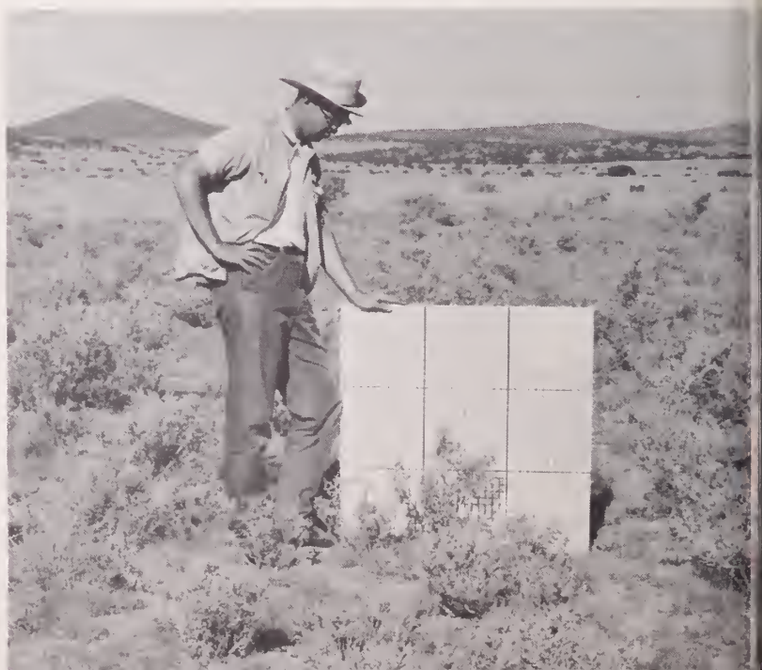
Pitted

GRAIN DRILL

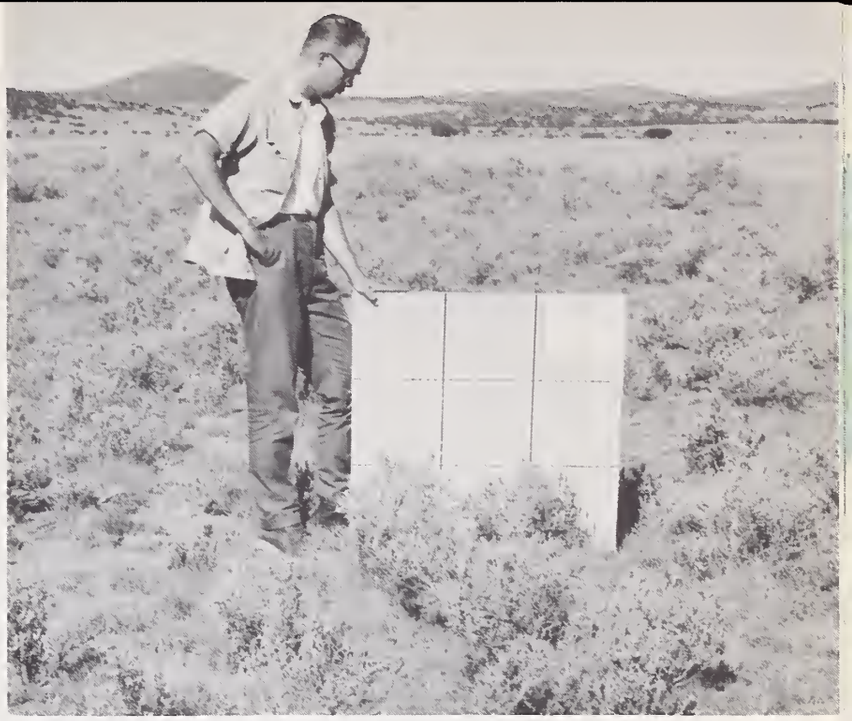
Figure 4.--
Appearance of chamiza stands in August 1962, 11 years after they were seeded by different methods.

Plowed

Plowed-pitted



Unprepared seedbed

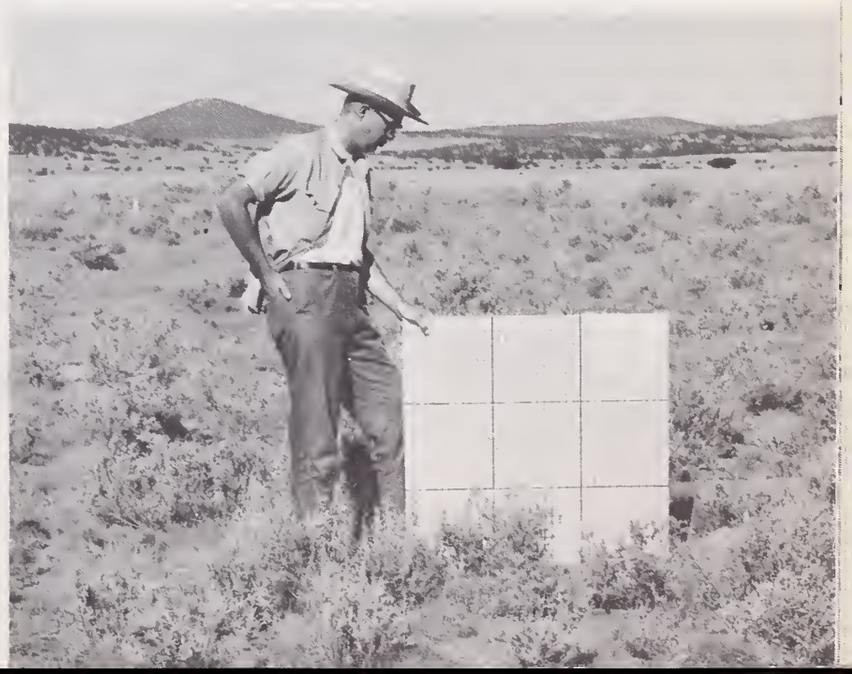


Pitted

CULTIPACKER-SEEDER

Plowed

Plowed-pitted



seedlings present on prepared seedbeds in 1951 survived as mature plants in 1962, as shown below:

Method of seedbed preparation	Survival (Percent)
Pitted	41.4
Plowed	29.9
Plowed-pitted	35.4

These figures suggest that pitting may have aided plant survival.

Young plants of chamiza--plants that became established several years subsequent to 1951--were relatively numerous. In general, their number in 1962 was proportional to the number of mature chamiza plants present:

Method of seedbed preparation	Mature plants (Number per milacre)	Young plants (Number per milacre)
None	5.1	0.9
Pitted	11.0	2.6
Plowed	12.2	2.1
Plowed-pitted	12.9	2.8

Native grasses became reestablished in pits and on plowed areas during the 11-year period. Although the extent of this recovery was not evaluated, it may have affected survival and growth of chamiza.

Plant Heights and Diameters

Average heights of chamiza plants in 1962 were about the same, regardless of the method of seedbed preparation or seeding (table 2). None of the apparent differences was significant.

Diameters of individual plant crowns likewise were nearly the same. Crowns of plants on unprepared seedbeds were as large as those on pitted or plowed seedbeds.

Crown Cover of Chamiza Stands

Crown cover of shrub stands is usually a reliable index to the amount of browse available and to the effectiveness of the stands for soil protection. Cover of the seeded stands at Monica was computed by multiplying average crown area of individual plants by the average number of plants per milacre plot. Crowns were assumed to be circular.

Crown-cover measurements in 1962 indicate that chamiza cover on prepared seedbeds was substantially better than on the unprepared seedbed (fig. 5). While figure 5 shows greater crown cover on the plowed and plowed-pitted areas than on the area pitted only, these greater cover measurements were not significant.

Table 2.--Average heights and diameters of chamiza plants in 1962

Method of seedbed preparation	Average height		Average diameter	
	Grain drill	Cultipacker-seeder	Grain drill	Cultipacker-seeder
	Inches			
None	12.3	10.7	11.8	11.2
Pitted	10.9	10.4	10.8	10.5
Plowed	13.0	11.8	12.3	11.7
Plowed-pitted	13.8	10.6	12.8	10.5

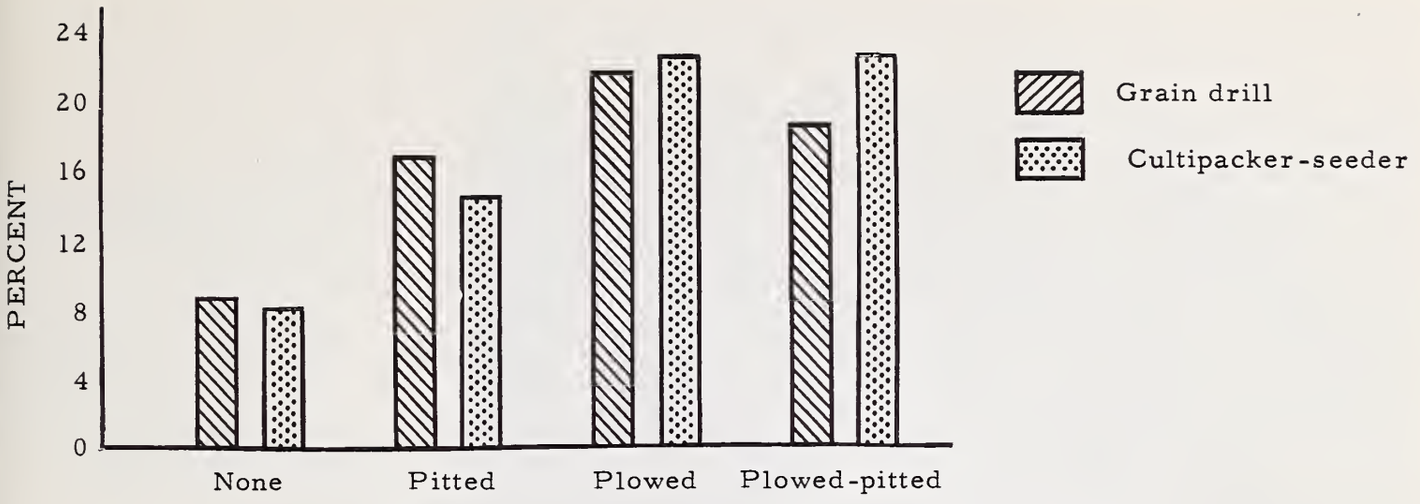


Figure 5.-- Crown cover of chamiza stands in 1962.

Weather conditions no doubt affected the success of the test seedings. Precipitation at the nearest Weather Bureau stations, Magdalena (38 years of record) and Augustine (24 years of record), was below average during the first 6 years:

Year	Magdalena	Augustine
	(Inches of precipitation)	
1951	6.42	7.71
1952	9.13	9.37
1953	8.20	8.35
1954	10.19	10.54
1955	8.31	7.99
1956	7.24	4.22
1957	13.64	13.27
1958	12.60	9.32
1959	15.38	7.72
1960	9.68	12.51
1961	12.49	11.30
Average:		
11-yr.	10.30	9.30
Long-term	12.36	11.02

During the 11-year period, 1951 through 1961, precipitation at Magdalena was less than the long-term average 7 years and at Augustine it was below average 8 years. Growth of the chamiza plants probably was curtailed because of the relatively dry weather that prevailed.

Growth of chamiza may also have been influenced by conditions of the soil and native plant cover. Soils at Monica are underlain by a compact caliche layer at depths of 10 to 16 inches. No chamiza plants are found naturally near the experimental site. The closest native stands are on somewhat deeper soils several miles away. A fairly dense native grass cover at Monica no doubt had some effect on establishment and growth of the chamiza, particularly where the seedbed was not prepared (fig. 6).

CONCLUSIONS

Seedbed preparation probably is necessary to obtain good stands of chamiza in western New Mexico. Although plants were successfully established by drilling or cultipacker-seeding on an unprepared seedbed, the resulting stands were much poorer than those on prepared seedbeds.

Under certain conditions, the seeding of chamiza on unprepared seedbeds could be a worthwhile practice. For example, many ranges in the Southwest support a satisfactory cover of herbaceous plants but no browse. On such ranges, particularly those reserved for winter grazing, drilling chamiza into the undisturbed herbaceous cover might result in a fair stand of browse needed to supplement the animal diet.

Figure 6.--
Native ground cover on this untreated check plot in 1962, as in 1961, was mainly blue grama with a few plants of ring muhly, three-awn, and wolftail. (Chamiza stand at left was established by cultipacker-seeding on a pitted seedbed).

Of the methods of seedbed preparation tested, none proved definitely superior. Where the native cover is composed mainly of undesirable plants, plowing probably would be preferable. But where there is a remnant stand of desirable species, pitting is perhaps better than plowing. Although in this study pitting gave no advantage over plowing, the method deserves consideration because it damages only about a third of the native cover and is cheaper than plowing.

Neither of the two methods of seeding tested was found generally superior. The results suggest that drilling is a better method for seeding unprepared or pitted seedbeds, however, while cultipacker-seeding is better for seeding loose seedbeds.

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